

PHILBRICK RESEARCHES, INC.

ALLIED DRIVE at ROUTE 128, DEDHAM, MASSACHUSETTS 02026

PRICE LIST
1 DECEMBER 1966

PHILBRICK
ELECTRONIC
ANALOG
COMPUTING
EQUIPMENT

for

MODELLING
MEASURING
MANIPULATING
& MUCH ELSE

Prices subject to change without notice
Minimum order \$15.00

Terms: Net 30 Days
FOB: Dedham, Mass.

REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE FREE WORLD

OPERATIONAL AMPLIFIERS

PHILBRICK SOLID STATE EQUIPMENT

PREMIUM GRADE				
MODELS	1-4	5-14	15-24	
P2A	\$227	\$218	\$218	
SP2A	180	178	175	
SP2B	195	193	189	
SP102	295	284	270	
P12Q	145	138	130	
PP12Q	145	138	130	
P18Q	85	80	75	
PP18Q	85	80	75	
P25A	135	129	122	
PP25A	135	129	122	
P25AH	154	148	139	
Q25AH	180	180	180	
P35A	98	94	87	
PP35A	98	94	87	
P45A	118	110	98	
P45AL	95	89	79	
PP45	118	110	98	
PP45L	95	89	79	
P55A	49	48	46	
P55AH	53	51	48	
PP55A	49	48	46	
PP55AH	53	51	48	
P65A	65	63	61	
P65AH	69	66	63	
P65Q	69	66	63	
PP65A	60	58	56	
PP65AH	64	61	58	
PP65Q	64	61	58	
P75A	98	94	87	
PP75A	98	94	87	
P85A	65	63	61	
P85AH	98	93	89	
PP85A	60	58	56	
Q85AH	161	161	161	
SP456 *	227	217	204	
SP65A *	180	171	161	
SP65AH *	189	177	165	
SP656 *	195	185	172	

* SPECIFY "MECHANICAL" or "PHOTOCHOPPER"

UTILITY GRADE				
MODELS	1-4	5-14	15-24	
P2AU	\$130	\$130	\$130	
SP2AU	138	138	138	
SP2BU	145	145	145	
P12QU	111	110	105	
PP12QU	108	107	102	
EP12QU	108	107	102	
P18QU	62	60	57	
PP18QU	59	57	54	
EP18QU	59	57	54	
P25AU	89	89	89	
PP25AU	79	79	79	
EP25AU	85	85	85	
P35AU	62	62	62	
PP35AU	54	54	54	
EP35AU	60	60	60	
P45AU	89	87	83	
P45ALU	65	64	61	
PP45U	89	87	83	
PP45LU	65	64	61	
EP45AU	87	85	81	
P55AU	20	20	20	
EP55AU	19	19	19	
PP55AU	15	15	15	
P55AHU	24	24	24	
EP55AHU	24	24	24	
PP55AHU	19	19	19	
P65AU	33	33	33	
P65AHU	37	37	37	
P65QU	37	37	37	
PP65AU	30	30	29	
PP65AHU	34	34	32	
PP65QU	37	37	37	
EP65AHU	35	35	35	
EP65QU	35	35	35	
EP65AU	31	31	31	
P75AU	68	66	63	
PP75AU	68	66	63	
P85AU	33	33	33	
PP85AU	25	25	25	
EP85AU	31	31	31	

MODELS				
1-4	5-14	15-24		
P25C	\$145	\$139	\$131	
PP25C	145	139	131	
P35C	118	113	107	
PP35C	118	113	107	
P45C	133	123	110	
PP45C	135	125	112	
P45CL	110	103	91	
PP45CL	110	103	91	
P65C	80	77	75	
P65CH	84	80	77	
PP65C	75	72	70	
PP65CH	79	75	72	
P85C	85	83	81	
PP85C	80	78	76	
Boosters				
P5	\$48	48	48	
P66A	39	38	36	
PP66A	40	39	37	
OSP65-50/50	85	82	76	
OSP65-100/10	85	82	76	

REGULATED POWER SUPPLIES

		1-4	5-14	15-24
OSPR30A	Chassis Plug-in	\$ 93	\$ 92	\$ 91
OSPR30	Chassis Plug-in	93	92	91
SPR30A	Chassis Plug-in	98	97	96
SPR-30	Chassis Plug-in			
PR-30	Bench Unit	± 15V at ± 30mA	98	97
PR-30C	Chassis Unit			96
PRH-60	Bench Unit	± 120V at ± 60mA	300	287
PRH-60C	Chassis Unit			269
PR-300	Bench Unit			
PR-300C	Chassis Unit	± 15V at ± 300mA	285	272
PR-300R	3½" Rack Unit			254

SPECIAL POWER SUPPLIES

SPDR-1	Chopper Driver Unit	1-4
6510	DC-DC Polarity Inverter	\$ 95
		79

TRANSCONDUCTORS

PL1-N/P	Dual Logarithmic Transconductors	\$ 40
PPL1-N/P		
PL2-N/P	Quadruple Logarithmic Transconductors	60
PPL2-N/P		
PL3	Quadruple Logarithmic Transconductors	60
PPL3		
PPL4-N/P	Logarithmic Transconductors — Temperature Compensated	59
SPL4-N/P	Logarithmic Transconductors — Temperature Compensated	97
SPLR-N/P	Log Ratio Transconductor	290
PSQ-N/P	Quadratic Transconductor — Squaring & Rooting	195
SPLOG-N/P	Logarithmic Transconductor	195
SPSIN-N/P	Sinusoidal Transconductor	195
SPCOS-N/P	Sinusoidal Transconductor	195
SPFX-N/P	Arbitrary Function Fitter	195

UNIT OPERATORS

SPL4A-N/P	Logarithmic Operator	\$227
SPLRA-N/P	Log-Ratio Operator	390

SWITCHING UNITS

SPG1	Diode Current Gate	\$ 70
SPREL	Relay Unit	70
SPT&H	Track & Hold Modulator	195

Q3 OPERATIONAL MODULES & POWER SUPPLIES

Q3-A1P	Stabilized onefold (SP656M), self-powered including line cord and dress covers	\$466
Q3-A2P	Differential onefold (SP2B), self-powered including line cord and dress covers	495
Q3-M1P	Multiplier/Divider, self-powered, including line cord and dress covers	980
Q3-M2P	Multiplier/Divider, self-powered, including line cord and dress covers	880
Q3-UP	Uncommitted Q3 Module with power supply (± 15V at ± 30mA) —	
	With line cord	140
	Without line cord	135
Q3-U	Uncommitted Q3 Module	
	With rear connectors	29
	Without rear connectors	20
QPR-300	Regulated Power Supply (± 15V at ± 300mA)	
	Bench Unit with line cord and dress covers	300
QPRH-60	Regulated Power Supply (± 120V at ± 60mA)	
	Bench Unit with line cord and dress covers	315
Q3	Accessories and Hardware (See 4-page brochure Q3 modules & cases)	

OPERATIONAL MANIFOLDS

MP	Fourfold self-powered, including 4 EP85AU Amplifiers	\$390
RP	Fivefold self-powered, including 5 EP85AU Amplifiers	495

ACCESSORIES

OP-0	Unwired P-size plug-in board and 10-terminal socket	\$4.30
P-0	Unwired P-size plug-in unit metal case and 10-terminal mating socket	8
SP-0	Unwired SP-size plug-in unit, metal case and 15-terminal mating socket	11.50
OSP-0	Unwired SP-size plug-in board and 15 terminal mating socket	5.50
MAK-1	Mechanical Accessory Kit for MP or Q3-A1P	72
CCK	COMPUTING COMPONENT KIT for MP or Q3-A1P	
-U	Electrical components only	60
-M	Plug-mounted electrical components	151

PHILBRICK VACUUM TUBE EQUIPMENT

OPERATIONAL AMPLIFIERS

	1-4	5-14	15-24
K2-W	\$ 25	\$ 25	\$ 24
K2-XA	45	45	43
K2-WJ	65	63	61
K2-YJ	80	79	77
SK2-V	65	65	64
K2-P, PA Stabilizer	52	52	52
K2-PJ Stabilizer	85	81	81
SK-2P Stabilizer	70	70	68
K2-BJ Booster	54	51	48
SK2-B Booster	44	44	44
USA-3	98	89	79
USA-3-M3	128	120	120
UPA-2	149	142	142
USA-4JX	198	193	193
USA-4JT	198	193	193

REGULATED POWER SUPPLIES

R-100B	RACK PANEL	$\pm 300V$ at $\pm 100mA$	\$225	\$220	*
R-300	RACK PANEL	$\pm 300V$ at $\pm 300mA$	475	465	*
R-600	RACK PANEL	$\pm 300V$ at $\pm 600mA$	775	760	*

OPERATIONAL MANIFOLDS

6009	Tenfold (10 K2-Ws)	\$520
HK	Tenfold (10 K2-Ws)	435
MK	Fourfold, Self-powered (4 K2-Ws)	465
K7-A10	Tenfold, Stabilized (10 USA-3s)	1365
SK5-H	Fivefold, Stabilized (5 SK2-V + SK2-P + Booster)	1150

UNIT OPERATORS

SK5-U	Universal Linear Operator	\$1850
SK5-M	Arbitrary Multiplier/Divider	1850
SK5F	Arbitrary Function Component	1950
5934	Display System	9800
MU/DV	Duplex Multiplier/Divider $\pm 50V$	775
	$\pm 100V$	820

ACCESSORIES

AP-2	Signal Cords (Banana-type connectors)	\$ 3
	Black or Gray/8", Blue or Green/24", Red or Yellow/36" (All stackable)	
PA	Plug Adaptors, telephone male	2
SK5-R	Relay Control Component	375



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Model Q25AH

High-Performance Differential Operational Amplifier

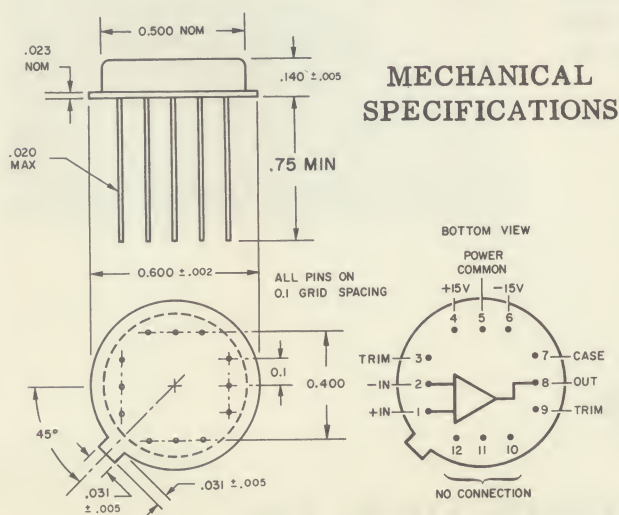


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The Q25AH Differential Operational Amplifier provides a combination of outstanding performance characteristics heretofore unattainable in a microminiature Operational Amplifier: high-speed operation, very high input impedance, extremely small current offset, low noise, and generous operating voltage ranges for both input and output signals. This unique combination is made possible by Philbrick's "NEW BREED" ("micro-hybrid") construction, which exploits the best features of the two component technologies --- integrated circuitry and discrete-element circuitry --- to produce a design with all of the desirable features of the monolithic microcircuit technique, but without any of the weaknesses inherent in a totally-committed, monolithic-chip construction.

A principal advantage of the "micro-hybrid" is its virtual immunity to external circuit or signal stress --- shorts, overloads, overvoltage, excessive signal input, etc. Other advantages include: larger output voltage swing; higher slewing rate; and positive assurance of dynamic stabilization by simple, straightforward circuit-compensation techniques.

The complete amplifier is enclosed in a low-profile TO-8 transistor case. Its components and construction are of the highest quality --- all-silicon semiconductors (including an FET input stage), conservatively-rated circuit elements, and hermetic sealing in an isolated metal case (permitting driven guard connection).



SPECIFICATIONS

Typical at +25°C unless otherwise indicated

VOLTAGE GAIN (DC open loop)			
+25°C,	rated load,	min.	20,000
	10 kΩ load,	min.	40,000
	100 kΩ load,	min.	80,000
-25°C to +85°C,	rated load,	min.	15,000
-55°C to +125°C,	rated load,	min.	10,000

RESPONSE open loop			
Small signal:	Unity gain-bandwidth	min.	30 MHz
	Gain at 1.0 MHz		40
	Gain at 10 MHz		4
Large signal:	Full Output	min.	0.1 MHz
	Rate limit		8 V/μ-sec

INPUT VOLTAGE RANGE			
Voltage range, both inputs	(operating)		±11 V
	(fault)	abs. max.	±15 V
Voltage range, between inputs (fault)		abs. max.	±30 V
CMRR, DC (±10 V range)		min.	5,000:1

INPUT IMPEDANCE			
Between inputs		10 ¹¹ Ω	3 pF
Negative input to common		10 ¹² Ω	6 pF
Positive input to common		10 ¹² Ω	6 pF

INPUT VOLTAGE OFFSET			
Without external trim		max.	10 mV**
Vs Temp. (+10°C to +60°C)		max.	3 mV
Vs Temp. (-25°C to +85°C)		max.	6 mV
Vs Temp. (-55°C to +125°C)		max.	12 mV
Vs Time (per day)			50 μV
Vs Time (1/2 hour)			10 μV

INPUT CURRENT OFFSET			
25°C		max.	-150 pA
Vs Temp. (+10°C to +60°C)		max.	1 nA
Vs Temp. (-25°C to +85°C)		max.	10 nA
Vs Temp. (-55°C to +125°C)		max.	200 nA
Vs Time (per day)			3 pA
Vs Time (1/2 hour)			1 pA

INPUT NOISE			
(a) Flicker (0.016 to 1.6 Hz)			
	voltage p-p		5 μV
	current p-p		2 pA
(b) Broadband (1.6 to 160 Hz)			
	voltage rms		2 μV
	current rms		1 pA
(c) Broadband (0.16 to 16 kHz)			
	voltage rms	typ.	2 μV
		max.	4 μV
	current rms		2 pA

OUTPUT (-55°C to +125°C)			
Voltage			±11 V
Current			±2.2 mA
Load (rated)			5 kΩ

POWER REQUIREMENTS*			
Voltage			±15 V
Current from positive supply: (Quiescent)			6.6 mA
	(Full Load)		6.6 mA
Current from negative supply: (Quiescent)			6.6 mA
	(Full Load)		8.8 mA

TEMPERATURE RANGE (degrees Centigrade)			
Operating: Rated			-55 to +125
Storage		max.	-62 to +150

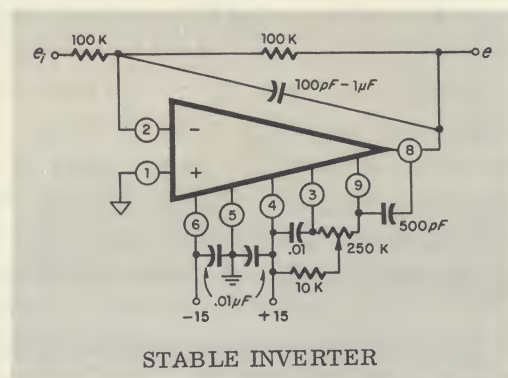
*At +85°C, power requirements typically 10% higher than at +25°C.
For 'worst case' add ±15% at any temperature.

**Adjustable to zero externally.

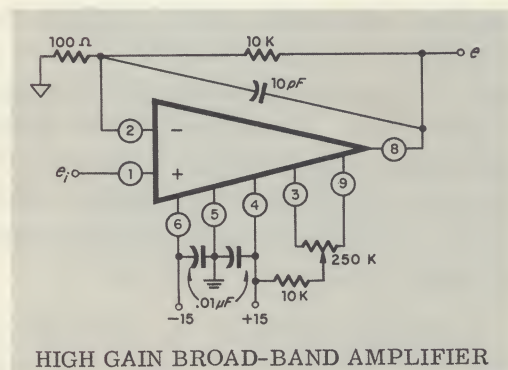


Q25AH combines the capabilities formerly available only in separate amplifiers (PP65AH for fast response, PP25A for the extremely high input impedance and low input currents obtained from an FET input) to accomplish a difficult task: perform in a unity gain follower with full output to 100 kHz. Q25AH performs equally well in most of the standard circuits described in the voluminous Philbrick applications literature. This flexibility is achieved by "custom tailoring" of the gain vs. frequency characteristics of the amplifier by means of external capacitors.

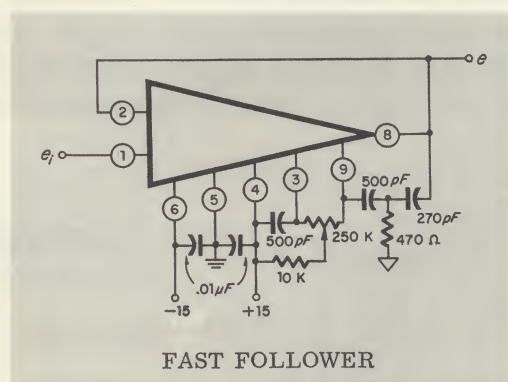
With $.01 \mu\text{F}$ between pins 3 and 4 and 500 pF between pins 8 and 9, the amplifier is docile in virtually all inverting applications, and tolerant of capacitive loading. The usual capacitor across the feedback resistor should not be forgotten.



A high-gain inverting or non-inverting amplifier (gain of 100 or higher) can be "broad-banded" by omitting the "tailoring" capacitors and using a very small feedback capacitor. Avoid capacitive loading.



With the special stabilizing network shown, a stable, fast unity-gain follower can be built. The voltage trim potentiometer and $10 \text{ k}\Omega$ resistor can be omitted if a few millivolts of voltage offset can be tolerated.



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